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A Proposed Index for Collaboration and Cooperation in Undergraduate Project Teams

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Abstract

All business teams require a mix of individual and group work. This study seeks to identify the levels of individual and group participation necessary to successfully complete projects in the undergraduate classroom. The levels of effort based on time, graded output, and satisfaction will be indexed on a scale from cooperative (working individually) to collaborative (working together). Initial analysis suggests that teams which predominately cooperate are often more successful than teams that predominately collaborate.

Keywords: Collaboration, Cooperation, Small Groups, Student Teams, Database Projects

Introduction

Within university classes, team projects are an important training technique designed to teach students leadership skills, project management, and the value of working together. Businesses desire employees with strong interpersonal and teamwork skills, therefore business schools aim to prepare students to successfully work in teams. In addition, these team projects improve each student's ability to work on more complex tasks than what could reasonably be expected for one student (Cohen, 1994). Because they want to enrich their students with valuable training, many Information Systems (IS) professors utilize group projects within their classes.

Although team projects are beneficial, evidence suggests that some students excel within groups, while others flounder. Students must overcome variables that pose difficulties such as coordinating around team members' classes, work, and extracurricular activities. Otherwise, professors will be bombarded with requests from students wishing to work alone or complaints about free riders. If left unresolved, professors face a dilemma of how to fairly assign grades for teamwork.

This pilot study proposes a mix of team collaboration and cooperation that creates successful outcomes in undergraduate IS classes. This research seeks to differentiate patterns of student teams with high performance outcomes (e.g., grade on task) from patterns of student teams that lead to low performance outcomes.

Background

In previous research, the terms collaborative and cooperative learning have been used interchangeably. However, Du and Johnson clarifies the distinction between the two terms (Du and Johnson, 2003). Collaboration is defined as a synchronous, coordinated effort by a group working together (Roschelle and Teasley, 1995). Cooperation is defined as completion of tasks individually.

Studies involving both collaborative and cooperative learning have proven that teamwork increases student achievement over individual work (Johnson, 1989; Hertz-Lazarowitz, 1992). In addition, teamwork is an important skill set in business, especially IS. Leitheiser's study determined that interpersonal and teamwork skills were the top skills required for IS professionals (Leitheiser, 1992). Since working on teams effectively is a crucial skill for both business and IS students, creating a best practices methodology of teamwork is important.

Studies reveal that the ultimate success of the team is dependent on several variables. Schedule conflicts, long commutes, and prior disposition towards group work are several factors that affect the group's decisions in either collaborating and completing work as a whole or cooperating, and completing tasks individually (Fellers, 1996). In addition, the grouping of students homogenously or heterogeneously according to academic achievement has been cited as an important factor. Previous research recommends heterogeneous teams to induce collaboration (Fellers, 1996). However, other studies determined that grouping students homogeneously surpassed the performance of heterogeneous groups (Baer, 2003). In this study, data were collected from one classroom of homogeneous groups and compared to three classrooms of heterogeneous groups.

Research Question

This research seeks to identify the mix of collaboration and cooperation that leads to student success in the group project. Scores on the group project were identifies as a measure of student success. Our research questions follows:

RQ#1: What mix of collaboration and cooperation in a group project fosters student success?

RQ#2: What mix of collaboration and cooperation in a group project fosters the highest satisfaction?

Methodology

Survey methodology was used in this study. The pilot study was conducted in the introductory computer information systems course required of all undergraduate business students. The course was administered at a large urban university in the southeastern United States. The course offers a challenge to students as it covers a wide spectrum of topics in information systems (breadth) but does not go into detail on each topic (depth). Four separate classes, with four different instructors, were assessed in this study. There were no pre-requisites for taking this course. Although helpful if a student possessed experience with computers, a student was expected to succeed in this class even if they had yet to experience any aspect of, or use of a computer. Students were expected to have access to a computer, either at home or on campus, during the course of the semester. There are several computer laboratories available for student use across the university campus.

Students enrolled in the course were required to complete two group projects. The group project under study was the first of the two group projects and was conducted during the weeks nine through eleven during a 15-week semester. The students had taken two tests, and had finished their first individual project by the time the group database project was administered. A previous individual project was in creating, tables, queries, reports, and entries to a database using Microsoft Access. This training was done to give all students the fundamental skills needed in the team project. The individual project prohibited any collaboration or cooperation between the students. The first group project was similar to the individual project, but allowed collaboration or cooperation within the group although not between groups. The second group project was a research paper on a topic in Information Systems. The groups were allowed to select their topic from a list of options. The second project was administered after the third test in the course.

Students were offered an opportunity to be part of the study or opt out of the study. The students were offered this option during the eighth week of classes. Students that chose to participate in the study were required to take four surveys: one demographic survey (15 questions) and three attitude surveys (A, B & C asking 25 questions each) designed to measure the student's history and experience in group projects. The survey instruments were adopted from Du and Johnson (2003). The satisfaction of the students was first to be measured by their feedback from working with the other team members. During the pilot study, it became apparent that this strategy was not working for this research project. The second pilot iteration looked at satisfaction of individuals as measured by instruments adopted from Fellers (1996). The data was collected in survey A and

C to find changes in satisfaction of group work. The demographic survey was released after the student gave their consent to participate in the study during week eight. The three surveys on group projects (named chronologically, A, B, and C) were administered in sequence: survey A, first group project, survey B, second group project, and survey C.

If the student chose to opt out of the study, a 75 question true-false quiz was released covering the course material requiring the same time as the four surveys. Either option for the students, whether participation in the group project or the quiz option netted, the students a possible five points toward the final student grade. The total possible points for the semester was 500 points, thus the study had a marginal impact of 1% on the student's grade. The students were given the opportunity to opt out of the study at any point in time during the semester after the option to participate in the survey. The pilot study had 30 student participants in each class.

Group Project One: Database Project

The database design project requires a team of three students to normalize, import, and modify a series of tables as well as creating specific tables, queries, reports, and an input form. The database project required the use of Microsoft Access.

Student teams were formed after the drop date for the course to insure team members will continue with their teams. Each group had a total of three weeks to complete the assignment as a team. Students were expected to complete this assignment outside of class and submit their materials electronically for assessment. Group assignments were made at the midterm after two exams and one major independent assignment had been made. This way the researchers were able to measure the grades of the students up until the beginning of the first group project.

Students were assigned in groups of three, in one of the four classes. The other three classes allowed self-selection, where the groups were free to form. The students were assigned into groups as to not create any variance in the group's average class score. Therefore the difference between average scores of members of group 1 and average scores of members of group 2 were minimized. Groups were also assigned as to minimize the effects of gender and culture. For example, no groups were assigned where all members were of one gender, or from one cultural group.

Every student, whether they participate in the study or not, was required to fill out an individual log sheet or journal. In their logs, students were required to fill out date, start time, end time, location, description of their activity, teammates present, and an issues section. Students were directed to include any activity from their own point of view, thus group meetings of three, two, and individual work was recorded. Therefore, each student log from the same group should be different. The individual logs were not graded for assessment.

Every student, whether they participate in the study or not, was required to fill out an individual bonus sheet. This was utilized to measure the students satisfaction with the group project. Each student filled out their own sheet and their submissions were confidential. For the first project (three person groups) there was $10,000 that each individual was asked to allocate to their two group members. For the second project (two person groups) there was $5,000 that each individual was asked to allocate to their partner. The students were allowed to allocate up to the amount for both group projects. Thus they could allocate all, some, or none of the pool money they had for the bonuses. If there was a discrepancy in the amount of money allocated in the bonus, each student was asked to explain and justify the discrepancy. For the first project a discrepancy was an uneven allocation of the bonus. For the second project a discrepancy was a bonus of anything lower than $5,000.

Group Project Two: Research Paper

The second project was a research paper with two students in each group. The project consisted of research into a topic in information systems (depth) approved by the instructor. The students were required to create a four-page paper and a five-minute presentation on the topic.

One class had teams assigned while the other three classes used self-selection. In the first group, the students were assigned to groups based on the class mean at week eight of the semester. Thus one group might have one 90 point student and one 70 point student, while another group might have two 80 point students. Thus the average grade for both groups was 80 points. Gender and culture were also taken into account while assigning teams.

As with the first group project, students will be required to keep a log of their activities. This log was identical in form to the one in the first group project except for the fact that there were only two people listed in the group instead of three.

Analysis

Five doctoral students coded the log data. The log data was assessed and measured according to collaboration or cooperation work. Cooperation work was considered work that can be split into individual tasks. Thus, any individual work was considered cooperation. Collaboration work is considered work that requires concurrent involvement among the students. Thus, any group work, whether it was two or three was considered collaboration. Time spent individually was measured as straight time. Each individual was considered a data point for this study. Thus each log data point was taken as it was received. Data discrepancy between members of groups was not considered. Thus in project one (three person groups) data was compiled for student A, student B, and student C, separately. Thus if there was any disagreements in time of group meetings between the students, data was not compared to find an agreement. If student A considered there to be a 30 minute meeting on November 1st, and Student B and C considered the same meeting to be 50 minutes long we did not change student A's time. This allowed for late arriving, early departing students to present their data in the correct fashion. Similarly for group project two (two person groups) data was not compared to the partner.

Wildly large numbers, those over 10 hours, we looked at closely. In these situations, when the data was collaborative (group meeting) nature, then log data from the other group members were considered. Also the location information, and time/date information was looked at to make sure that the facilities were actually open during those times. Most of these errors were in marking AM/PM incorrectly. For example, one student wrote that he met his team members from 9:00 PM until 9:30 AM in the university library. This would mean it was a twelve and a half hour meeting. When the other team members data was looked at they only met for 30 minutes (9:00 PM until 9:30 PM) in the library. The date was on a Wednesday and the university library closes at midnight on those nights. Thus in this situation the 9:00 PM until 9:30 AM was changed to 9:00 PM until 9:30 PM.

The time data was computed using the formula below to come up with an index value between zero and one. As the index moved closer to one, the group reflected more collaboration than cooperation. As the index moved closer to zero, the group worked reflected more cooperation than collaboration.

$$Index = \frac{Collaboration}{Collaboration + Cooperation}$$

The grading of the project was conducted by five coders. To ensure that there was consistency between all class sessions, all data was analyzed by the coders and an agreed upon grade was assigned. For classes that were outside the control of the researchers, the assignments were obtained and the grading was re-evaluated and a new grade was assigned for those students.

Due to the nature of the research question, it is necessary to distinguish between groups that were high in the index value and low in the index value. Since the students were to conduct their own group project, it is impossible to control and force students to conform to a certain value of the index. Therefore, no treatment was administered to any of the groups. With enough data, we were able to get a mix of groups on the index line between one and zero. This allowed us to realize any trend that might arise due to the collaboration and cooperation mix.

The outputs for the research questions were the grade and satisfaction. Grades were accessible to us and we were able to associate the index from each group to each individual group member's grade for the project. In fact, the project was graded equally so the group was given a grade as a whole. The satisfaction was an individual measure and was measured by the initial and final survey. Any changes in satisfaction would be attributed to the project in the class. The satisfaction was measured by the team members individual evaluations of each other. These evaluations were submitted individually and were not going to be made available to their team members. Thus students were free to rate their team members freely without the worry of their partners knowing how they were rated. In the database project, there were three members, thus each student was to allocate bonus monies of $10,000 to their two group members. If they thought that the work was done evenly, $5,000 each was in order. Otherwise they would allocated unevenly. They were obligated to distribute the whole $10,000. No matter how they allocated the monies, each student was required to justify the allocation. Each individual evaluation was coded. The difference in the allocation to the two group members was calculated. If there were no difference, $5,000 was given to each member, thus the difference was zero. If there were some notion that one partner did more than the other, then the difference would increase to a maximum of $10,000. Satisfaction was measured by this difference in the allocation of the bonus. If the difference was $0, then satisfaction was considered high, if the difference was at $10,000, then satisfaction was considered low.

In the research paper project, there were two members, thus each student was to allocate up to $5,000 in bonus to their partner. They were not obligated to use up the whole $5,000. If the rater did not allocate the maximum $5,000, the rater was to justify the reasons for not supplying the full amount to their partner. Satisfaction was measured by the amount of bonus

allocated. If the bonus was $5,000, the satisfaction was considered low, if the bonus was $0, then satisfaction was considered high.

Initial analysis of the data indicates that high collaboration is does not lead to student success. The groups that did receive a high score for the work tended to demonstrate a balance of cooperation and collaboration with cooperation being the stronger of the mix. The teams that did poorly tended to have a heavier mix of collaboration. The satisfaction metrics were not as conclusive.

Initial Conclusions

Only the initial data on the first 30 students (n=30) has been analyzed for group project one. Student log reports for 27 of the 30 students were received. At this stage of the analysis, no attempt has been made to control for group heterogeneity. The Index values ranged from 0.0546 to 1. The average Index was 0.575 with a standard deviation of 0.263. The grades of the individuals ranged from 41.5 to 58.5, out of a possible 60 points for the database assignment. The average grade was 52.1, with a standard deviation of 6.039. The five lowest grades were at 42 or below (42, 42, 41.5, 41.5, 41.5), all had an Index value higher that 0.72. The next lowest grade was a 49. There was one student with a high Index value (0.858) and a high grade (58). This means that if a student collaborated, or did most of the work in a group meeting, that student would likely receive one of the 5 lowest grades on the project. All students with an Index value below a 0.4 (six students), received a grade of 'A' (55.5, 58, 58, 58.5, 58.5, 58.5). This indicated that if a student tended to cooperated, or worked individually on tasks, received an 'A' on the project. In the mid-range of Index (between 0.4 and 0.72), there were fifteen students, that ranged in points from a 49 to 58. This resulted in grades were a 'B' or better.

The data for the second group project was also analyzed. Student log reports for 28 of the 30 students were received. The data here contained a few anomalies. The Index values ranged from 0.005 to 1. The average Index was 0.351 with a standard deviation of 0.310. The scores of the individuals ranged from 37 to 60, out of a possible 60 for the case research paper assignment. First there was a group that had received the lowest grade (37) that was an anomaly. The two individuals indicated a low Index (0.055, 0.061), thus being cooperative or working on individual tasks, but received a low grade. If this group was taken out of the data set, the patter looks similar to the first group project. There were four points above 0.7 on the Index value (0.798, 0.915, 1, 1). Of the four two received a 45, while the two that did no individual work (Index of 1) got a grade of 57 and 58. This may indicate a "free rider" or "controller" situation where one individual did all the work and the other did minimal work. If a student were lower than 0.25 on the Index value (10 students), an 'A' on the project was awarded (54, 54, 54, 55, 59, 59, 59, 59, 60, 60). In the mid-range (0.277 to 0.625) there were 12 students, ranging in score from 45 to 59 (45, 45, 51, 51, 52, 52, 54, 55, 57, 58, 59, 59). As in the first group project, this indicated that if a student tended to cooperated, or worked individually on tasks, an 'A' on the project was earned. In the mid-range of Index (between 0.277 and 0.65), there was a 83% (10/12) chance a student got a 51 or better ('B' grade).

The data suggests that there exists a mix of collaboration and cooperation at which grades do increase. It also suggests that there is a trend where the higher the collaboration, the lower the grade, and the higher the cooperation, the higher the grade. This is consistent with findings in previous studies (Du and Johnson, 2003)

The data also suggest that there is a difference in the Index value between the two projects. One was a database project, which had a higher Index (0.575) with a lower standard deviation indicating a tendency to work together at the same time. The research paper project tended to have a lower Index (0.351) with a higher standard deviation indicating a tendency to work individually, but there was more variance in how to break up the tasks.

The satisfaction for the database project (three person groups) was measured by the difference in the $10,000 bonus allocation. Each individual student was a data point. Student evaluations for 25 students were received. The difference ranged from $0 to a high of $9996.50. Fourteen of the 25 data points had a difference of zero dollars. The average was 1808.19 with a standard deviation of 3220.46. The data did not show any discernable result. For the research paper project (two person group) the measure was the $5,000 bonus. Student evaluations for 27 students were received. There was no range as every one of the evaluations awarded the full $5,000 to their partner. Thus the average was $5,000 with a standard deviation of zero. The $5,000 bonus data utilized was not a good measure for satisfaction. It seems that the students were willing to give good or satisfactory evaluations on both group projects. The class was also graded on a straight scale so there was less reason to give a fellow student a bad evaluation. The students that did allocate a difference in the database project did so because one member was not pulling their share of the work load. It would seem logical that a situation where one student did most of the work would show up in the second project, but the data did not indicate this. This may be a future area of study as smaller groups, such as a two person group, may have less variation in the evaluation process. Due to the lack of results from this data, the current study is employing a new strategy to measure the satisfaction found in the discussion/future studies section.

Further research and increased data points are needed in order to find a target Index (fixed mix of collaboration and cooperation) to maximize the performance of the group. Research question #1 is being addressed as data is still being evaluated at the writing of this paper.

Discussion

Due to the exploratory nature of the research there are several possible aspects of weakness to this study. First, the survey methodology may not be best suited to the study. It might be possible to observe the students or have a confederate measure all the tasks. No other means to observe the students team interaction was found since invasion of privacy is of utmost concern for the researchers.

Self reported logs may not be a true or accurate measure of the time spent on each task. This is an issue that relates to the first possible weakness. Students may have padded their data to look better in the eyes of the instructor, even though the log data was not being graded.

A third possible weakness is that the ability of student at the time of the first survey may not have been measured correctly with just two tests and one assignment. By assigning students based on grades measured by a partial semester, there will be groups that vary in their average final grade.

Future Research

Student satisfaction was not measured accurately using the evaluation of the team members. Future studies will take pre and post data on satisfaction with the group project utilizing metrics developed by Fellers. We utilized five metrics from this study. We are currently taking data for this study.

The task that the students are assigned seemed to have some effect on the collaboration/cooperation mix. This may also be a further study.

References

Du, S. M., and Johnson, R. D. (2003) Student Team Behavior: Cooperate or Collaborate? Proceedings of the 2004 International Conference on Informatics Education Research, Washington, DC.

Baer, J. (2003). "Grouping and Achievement in Cooperative Learning." College Teaching **51**(4): 169-174.

Cohen, E.G. (1994)."Restructuring the classroom: Conditions for productive small groups." Review of Educational Research 64(1):1-35.

Fellers, J. W. (1996). "Teaching Teamwork: Exploring the Use of Cooperative Learning Teams in Information Systems Education." Database for Advances in Information Systems **27**(2): 44-60.

Hertz-Lazarowitz, R. (1992). Interaction in Cooperative Groups: the Theoretical Anatomy of Group Learning. Cambridge, Cambridge University Press.

Johnson, D. (1989). Cooperation and competition: Theory and Research. Edina, Minn, Interaction.

Leitheiser, R. L. (1992). "MIS Skills for the 1990s: A Survey of MIS Managers' Perceptions." Journal of Management Information Systems **9**(1): 69-91.

McKeachie, W. J. (2002). "McKeachie's Teaching Tips", 11th Edition, Houghton Mifflin Co.

Roschelle, J and Teasley, S (1995). The Construction of Shared Knowledge in Collaborative Problem Solving. in O'Malley, C.E., (Ed), Computer Supported Collaborative Learning, pages 69-97. Springer-Verlag, Heidelberg.